INTRODUCTION

The term “Hispanic” represents a complex concept comprised of multiple characteristics of the members of this group. Demographic, social, and economic variables play an important role in the definition and conceptualization of the Hispanic population in the United States. It is necessary to pay close attention to each one of these variables because of their effects on many other aspects. The understanding and consideration of the variety of elements that affect the Hispanic population in a direct or indirect way represent an essential key to face the social changes and challenges that are related to the growth of this population.

Recent data from the U.S. Census Bureau confirm that Hispanics continue to be the largest and fastest growing ethnic group in the United States. At the present time, there are 42.7 million Hispanics in the United States, representing 49 percent of the national population growth in the past year (U.S. Census Bureau, 2006). This was primarily due to the increase in number of births and immigration.

In the state of North Carolina, a recent study found that Hispanics constitute seven percent of the state population. The main focus of the study was the economic impact of Hispanics in the state of North Carolina. Regarding this, it was found that Hispanics contribution to the state economy is more than $9 billion and it is expected that in 2009 this number will increase to $18 billion. Another remarkable finding of the study is the fact that 57% of the total growth in the state public schools was accounted by Hispanic students from the school years 2000-2001 to 2004-2005 (Kasarda & Johnson, 2006).

As previously mentioned, when we talk about the Hispanic population we have to keep in mind several aspects. One of them is related to the terminology used to designate

this ethnic group. As described by Comas-Díaz (2001), Hispanic was a term created by the United States Bureau of the Census to refer to people who identified themselves of Spanish origin. As this author explains, some people consider this term inaccurate because it implies a heritage link to Spain. Thus, others prefer the term Latina or Latino because it connotes a linkage to Latin America. Another aspect is race. According to the U.S. Census Bureau "people who are Hispanics may be of any race". This is an element that represents an issue when comparisons are made.

As explained by Puente and Ardila (2000), Hispanics are not a race; they are a very diverse ethnic group. There are a variety of differences and similarities within this population. They comprise a diverse group of people from different geographical areas and with different racial characteristics. For this reason, there are substantial differences among this group, which go beyond differences in language use. As described by Castex (1994), Hispanics come from 26 different countries among which significant differences in aspects such as language, economic resources, educational systems, culture, and ethnicity exist. The Spanish language is one of the major links that unite the different groups (Ramos, 2004).

Hispanics are a group comprised by multiple cultural traits, which are defined by the differences and commonalities of the diverse country of origins of its members. Due to the peculiarity of this group, there are several aspects that are prevalent when we try to answer the question what does being Hispanic mean. Despite the different characteristics that are present in this group, many agree that elements such as language, family ties, religion, and work are some of the cultural traits that comprise a common denominator within Hispanics. These traits are the same aspects that play important roles in the

development of this group within the U.S. society. For example, many of the difficulties that face the Hispanic population have their roots on these mentioned aspects, which lead to different issues. Aspects such as acculturation, language limitations, family problems, social support, limited education, financial problems, documentation, health, etc. are some of the main problems within Hispanics.

It has been argued that it is difficult to classify Hispanics because of different reasons. Ramos (2004) has indicated that the term "Hispanic" can refer to numerous elements not necessarily related to aspects such as race, social class, etc. According to this author "to be Hispanic is to be many things at once and to cease to be others" (Ramos, 2004, p. 32).

Ramos (2004) also noted that even though the terms "Hispanic" and "Latino" are used in an interchangeable way by some people, many describe themselves as Mexicans, Cubans, Puerto Ricans, etc. Those labels tend to group people together, while when the place of origin is specified, the large group is divided into multiple ones. Both of these terms emphasize on aspects related to the culture, geography, and language, without reference to racial elements, and this is what makes other people think about Hispanics in a new and different way (Ramos, 2004).

As previously mentioned, the increase in the Hispanic population is primarily due to births and immigration. Regarding this last aspect, the U.S. Census Bureau reported important data on foreign born population. Specifically, it has been described that 11.7 percent of the U.S. population is constituted for foreign born; 53.3 percent of those were born in Latin America (10.1 percent in the Caribbean, 36.9 percent in Central America, and 6.3 percent in South America). The same data show that 80.1 percent of this group of

foreign born population was between 18 and 64 of age in 2003. Other reports indicate that in 2005 the Hispanic population had a median age 27.2 years in contrast to 36.2 years of age of the whole population. The Hispanic population is relatively young.

Gutierrez (2004) has discussed that between the years of 1990 and 2000 more immigrants came to the United States than in any other period of time. One of the most important reasons why this pattern has occurred is because of the dramatic growth of the population in Latin America since 1960. This author explained that even though most of the immigrants from Latin America are from Mexico, the number of people from Central America, the Spanish-speaking Caribbean, and South America has increased, which put into context the internal heterogeneity of the Hispanic population.

Educational Profile of the Hispanic Population

One important aspect of the Hispanic population is the educational attainment. This aspect is of particular interest, especially when Hispanics are compared with other groups. It has been indicated that a common aspect in Hispanics who live inside and outside of the United States is the low levels of educational achievement (Puente & Ardila, 2000). Data on the educational attainment of the foreign born population in United States show that in general individuals 25 years of age and older are more likely to have lower levels of educational attainment in contrast to the native born population. Specifically, the report shows that the lowest percentage of high school graduates are from Latin America (49.1 percent); people from South America have higher percentage of people graduating from high school than people from Central America. Also, there are a low percentage of people from Latin America with bachelor's degree or other higher degrees.

Undoubtedly socio-economic variables such as education are very important when we are talking about Hispanics. It is significant because it has implications with many other important factors that need to be considered when seeking for answers and explanations about any particular matter. It is essential to take into consideration the multiple variables that, in some way or another, can provide the best comprehension and understanding. The Hispanic population in the United States is becoming a larger part of the total population, and this growing brings enormous challenges that need to be addressed in the most efficient way in order to guarantee the wellbeing of the entire population.

Despite the evidence supporting that the level of education of Hispanics is lower in contrast to U.S. born, it has also been reported that this gap has been getting smaller. Data on this narrowing gap was described by Lowell and Suro (2002), who conducted other analyses on the data regarding educational attainment of the Hispanic population. In contrast to the common knowledge regarding the educational levels of Hispanic immigrants, this report shows other interesting data that can contribute to the understanding of the development of this population.

Among the important points presented in the report, one of particular interest is the fact that according to recent data analyses, the educational attainment of the Hispanic population has improved in a significant way in the past years. It has been projected that this improvement will continue in the future. According to the report, the percentage of foreign born adult that completed their high school education has increased faster than the percentage of native adults. Also, it has been a markedly increase in the number of Hispanic immigrant that are continuing their education in United States.

Another important element pointed out in the report is the contrast between the educational attainment of Hispanics in the United States and those in Latin American countries. As discussed in the report, even though educational achievement has been improving in Latin America, those who immigrate to United States have higher educational profile than those who stay in their countries. It has also been reported that there are significant differences in educational attainment according to the country of origin. Specifically, immigrants from the Caribbean and South America have higher educational profiles than those from Mexico and Central America.

Neuropsychological Performance

It has been argued that variables such as age, education, language, and culture influence performance on neuropsychological tests (Ardila, Roselli & Puente, 1994; Ardila, 1995). However, even though the role played by these variables has been demonstrated by different research studies, it has not received the necessary attention, since the main concern regarding the measure of brain functioning has been directed toward the use of accurate instruments by the appropriate professionals (Ardila, Roselli & Puente, 1994).

This aspect represents a limitation in the study of the brain-behavior relationship, and consequently, the explanations and conclusions regarding this matter are limited. Particularly, this is a main aspect concerning the comprehensive understanding of individual differences in neuropsychological performance.

The Effect of Culture

Ardila (1995) has pointed out that clinical Neuropsychology has progressed in some specific areas such as the assessment of brain pathology and the establishments of

clinical/anatomical correlations; nevertheless the advance in the study and understanding of individual differences has been limited, particularly in the understanding of cultural differences or similarities. Others have suggested that professionals in the specialty of neuropsychology do not have the appropriate information regarding the role played by cultural factors on neuropsychological testing (Echemendia & Harris, 2004).

Culture is a very important factor that is present in all kind of human manifestations. It has been argued that cultural diversity may cause differences in behavior (Anastasi, 1988). Ardila (in press) has suggested that patterns of abilities, cultural values, familiarity, language, and education are potential cultural aspects that may influence neuropsychological test performance. Culture plays an important role in neuropsychological research, and it has enormous implications in the understanding of culturally different populations, and consequently in avoiding ambiguous conclusions due to the lack of knowledge and misunderstanding (Puente & Agranovich, 2003).

The influence of cultural factors has been studied in the specialty of cross-cultural psychology, which has primarily focused on comparisons between majority and minority groups (Nagayama & Maramba, 2001; Puente & Pérez-García, 2000a).Within the specialty of clinical neuropsychology, the assessment of people from diverse cultural backgrounds has been studied in the specialty of cross-cultural neuropsychology, however, this is something relatively recent (Puente & Perez-Garcia, 2000a). Others (Ardila, 1995; Ostrosky-Solis, Ramirez & Ardila, 2004) have pointed out that the specialty of neuropsychology has addressed the issue of individual differences in a very limited way, which have lead to a scarce and narrow understanding of cultural differences and similarities.

The most prominent work concerning the study of cultural factors within the field of psychology and neuropsychology has been characterized by the work of Lev Vygotsky and Alexander Luria. In collaboration with Lev Vygostsky and Alexie Leontiev, Luria developed an approach to study human psychological processes in which culture plays the main role (Cole, 1990). Vocate (1987) claimed that the concept of higher mental processes developed by Luria had its origins on Vygotsky's theories. This author discussed that Vygotsky stated that higher psychological functions had socio-cultural origins, and they are assimilated through social interactions. According to Luria (1976), higher mental processes are originated and shaped by historical, social, and cultural interactions.

Ardila (1995) has argued that the influence of cultural variables on the cognitive abilities assessed by neuropsychological measures is related to contextual experiences. Culture represents learned customs and ways of living shared by a group of people, and it involves common values and meanings, modes of knowing, and convention of communication within a group (Ardila, in press). Also, the same author proposed that culture is comprised by aspects such as values, beliefs, and style of behavior, which can affect neuropsychological testing in multiple ways (Ardila, 2005). Neuropsychological tests measure cognitive abilities related to learned abilities that are gained through learning opportunities and contextual experiences; aspects that are closely related to individual skills, thus different cultural environments produce different abilities (Ardila, 1995).

Pérez-Arce (1999) has discussed how individuals' behaviors are influenced by cultural factors regardless of the status of the brain. This author explained that variables

such as language, culture, education, and social status constitute individual's ecological contexts, and that the work of some authors in the field had put into context the importance of such aspects, particularly for neuropsychological test interpretation. Therefore, according to this author, the function of cross-cultural neuropsychology is to identify and understand what aspects are culturally shared by individuals and what are distinctive to each person.

It has been discussed that socio-cultural characteristics include different inter-related variables such as language usage, reading ability, level and quality of education, socio-economic status, contextual experiences, etc., that are very difficult to disconnect from each other (Shuttleworth-Edwards, et al., 2004). Also, it has been argued that among those important socio-cultural variables, level of education plays a significant role in neuropsychological testing, but the variable of education is difficult to differentiate from culture (Ostrosky-Solis, Ramirez & Ardila, 2004).

Cross-cultural Neuropsychology

A review of relevant databases in the specialty of neuropsychology conducted by O'Bryant, O'Jile and McCaffrey (2004) indicates that most of the published articles frequently report data regarding age, education, and gender, however, very few studies report data on race, ethnicity, native language, and acculturation.

Byrd, Sanchez and Manly (2005) claimed that the typical approach of comparing Caucasians to ethnic groups in the specialty of neuropsychology does not provide enough information regarding ethnicity-related variance. A better approach to studying of ethnic minorities would be one in which within-group comparisons are taken into account.

Even though theories and research have pointed out the importance of variables such as culture in the brain-behavior relationship, few research studies have focused on this topic, and more specific regarding Hispanic population (Puente & Agranovich, 2003; Puente & Pérez-García, 2000b). Studies including minority groups are limited (Puente & Pérez-García, 2000b); and in the case of Hispanics, researchers do not take into account their heterogeneity, and only a small part of this group is included (Puente & Pérez-Arce, 1997). Frequently those types of studies tend to group Hispanics as a homogenous group. On the other hand, a common practice in the neuropsychological assessment of Spanish speakers is the simple translation of tests without the establishment of appropriate norms for this particular population.

Neuropsychological Research and the Hispanic Population

Some research studies on the effects of cultural factors on neuropsychological functions have been conducted with Hispanics (Puente & Pérez-García 2000b; Comas-Díaz, 2001); however, the diversity within this group has not been addressed. Hispanics constitute more than the 12.5 percent of the population in the United States, representing the largest ethnic group since the 1980 census that includes Mexicans, Puerto Ricans, Cubans, Central Americans, South Americans, Dominicans, Spaniards, and others (U.S. Census Bureau, 2000).

It is still unclear whether the members of the Hispanic group are different. Hispanics are an ethnic group that can be divided into different subgroups, such as people from the Iberian Peninsula and people from Latin American, as well, such groups can be subdivided into groups from the Caribbean, Central and South America (Puente & Ardila, 2000). Therefore, the diversity between these groups is evident, and it comprises

geographic and cultural differences, which are characterized by the various ethnic, racial, national, and cultural backgrounds.

Hispanics are a very heterogeneous population since it is comprised by a variety of people from different backgrounds, which include different historical, economic, political, racial, etc., characteristics (Altarriba & Bauer, 1998). It has been argued that the term Hispanics hides this huge diversity and variability among this group of people who come from diverse countries (Robinson, 1998). Even though Hispanics are linked by a common language, there are considerable differences within this group, which usually go beyond obvious language variations and that comprise many other aspects such as food, dress, customs, etc. (Robinson, 1998; Puente & Ardila, 2000).

Regarding the diversity within the Hispanic population, Pontón and Ardila (1999) have argued that Hispanic heterogeneity includes ethnicity, acculturation, age, language ability, country of origin, and education; those variables, among others, influence the assessment of cognitive aspects, and, as consequence, the practice of neuropsychology with members of this group. Specifically, an element of particular interest is the statement brought by these authors, who argued that empirical research is highly necessary in order to answer questions regarding this heterogeneity such as "is country of origin a variable of interest in test performance after educational attainment has been partialled out? Or do the effects of these variables disappear once education is controlled for?" (Pontón & Ardila, 1999; p.569).

In his review of research papers regarding the use of neuropsychological research with Hispanics Gasquoine (2001) found that most of the published studies include samples of Mexican Americans, Puerto Ricans, Cubans, and Dominicans. Also, he found

that most of the published research was on older adults with significant differences on educational levels. The author concluded that the main topics include on those reviewed research are comparisons of Hispanics with Anglo-Americans on screening tests such as the Mini-Mental State Examination, comparisons in the performance on neuropsychological tests, study of the effects of variables such as bilingualism, acculturation and SES, and validation and standardization of neuropsychological tests. Accordingly, the assessment and interpretations that are derived from research and practice with Hispanics are limited.

Concerning each one of these main topics addressed by the studies, the author discussed important aspects that characterized most of the research reviewed. For example, regarding the comparison on cognitive screening tests, the author concluded that most of the results found on studies are biased against Hispanic due to a lot of inconsistencies related to translations, age range, educational levels, and problems with the use of appropriate statistical analyses. In relation to the performance on neuropsychological tests, the author discussed that the results have not been specific on the differences found, that is, the disparities cannot be simply attributed to aspects such as qualitative differences on education, problems with translations, or test content.

Some researchers have addressed different issues regarding the Hispanic population. Research studies, such as the one conducted by Ardila, Roselli and Puente (1994), have been done with the attempt to fill in the gap in the literature concerning neuropsychological testing. These researchers developed neuropsychological tests for Spanish speakers and provided normative data on those developed tests. The authors were motivated to conduct this type of research due to the lack of suitable instruments

and norms for this population. Specifically, they were interested in the development of appropriate tests and norms for old adults with low levels of education. The authors presented summarized data containing information on different age ranges and educational levels. They focused on neuropsychological tests that measure orientation and attention, language, memory, and spatial and praxic abilities.

In other research, Ostrosky-Solis, Ramirez and Ardila (2004) were interested in studying the effects of variables such as culture and education on neuropsychological test performance. In order to address this issue, the authors administered a brief neuropsychological battery to a sample of indigenous and non-indigenous populations from Mexico. The individuals included in this study were literates and illiterates with an average age of 54.6 years. The results only showed significant differences on visuo-perceptual, constructive and verbal memory tasks. Specifically, the illiterates indigenous performed better on visuo-perceptual and constructive tasks; however, they had lower scores on immediate and delayed verbal memory tasks. The authors of this study interpreted the results as an example of the influence of cultural and environmental variables in the development of skills. Therefore, the differences found can be attributed to environmental demands, which lead to the development of specific skills.

As previously discussed, other research studies have been conducted with the purpose of contrasting the performance of Spanish and English speaking individuals on different neuropsychological tests. Jacobs, et al. (1997) had a sample of demographically matched, randomly selected, community based, elder participants, in a study where Spanish and English speaking participants were compared on tasks that assessed cognitive functions that are usually affected in dementia. The Spanish speaking

participants were primarily from the Dominican Republic, Cuba, and Puerto Rico, have been in the United States for more than 15 years, and most of them reported Spanish as their primary language. The mean age of all participants was 75 years old. The researchers found that Spanish speaking participants had lower scores than their English speaking counterparts.

It is important to discuss that the instruments used in this study were tests translated into Spanish by the researchers, and no information about the norms used was provided. These researchers pointed out the importance of taking into consideration the relevance of culturally sensitive tests. Also, the authors discussed other aspects of this study that need to be taken into account when considering these findings. One aspect is education. The authors argued that even though subjects were matched on years of education that does not equate the samples because the difference in quality of education is not clear.

It has been discussed that comparisons of different ethnic groups through the application of cognitive ability tests represents a major problem when the appropriate standardization is not available (Shuttleworth-Edwards et al., 2004; Puente & Bure, 2006). When majority and minority groups are compared, the differences are attributed to shared socio-cultural variables of a particular ethnic group, which represents a critical aspect because an ethnic group may not have homogenous socio-cultural characteristics (Shuttleworth-Edwards, et al., 2004).

These are some of the reasons why it is important, among other aspects, to conduct research to describe and understand the effects of culture in the neuropsychological assessment of Hispanics. It is important not only to conduct

between-group comparisons, within-group contrasts should be a main concerned as well (Puente & Pérez-García, 2000b). Other authors have discussed that there are questions that need to be addressed when dealing with culturally diverse groups. In the case of Hispanics, Castex (1994) discussed that questions such as "what is the Hispanic population? If subgroups are diverse, in what ways are they diverse and in what ways are they similar? What does it mean for culturally and racially diverse people to be perceived as members of a single ethnic group?" (p. 288). It has been indicated that within-group variation represents an important component; however, it has not received appropriate attention in the field of cross-cultural neuropsychology (Byrd, Sanchez & Manly, 2005).

Ardila (1990) has discussed that the pattern of development of the specialty of neuropsychology in Latin American has also played an important role in the generation of research with Hispanics. The author pointed out that even though there has been an increase in the number of professionals and research, difficulties such as economic limitations, lack of information in Spanish, etc., have caused some problems in the development of neuropsychology. Also, it has been argued that the neuropsychological community in Latin America has paid more attention to theoretical issues than neuropsychological assessment (Ardila, 1999).

Considering all the issues above, it is important to conduct research where group diversity is taken into account. Research studies where within group heterogeneity is taken into consideration are necessary, since the Hispanic population comprises a wide and diverse group. The knowledge of important aspects such as language and culture represents a big step that will lead to better understanding of Hispanic as an ethnic-minority group in United States and as a heterogeneous population in general.

Consequently, a comprehensive understanding of individual differences will be reached, and better approaches can be applied to provide appropriate treatments and interventions.

It is important to conduct research that could contribute to the comprehension of the importance of understanding, integrating, and applying multiculturalism into neuropsychological research and practice, as well to the understanding of integrating cultural diversity into neuropsychological assessment. The purpose of this research study is to evaluate whether different Spanish speaking groups perform differently in neuropsychological tests that measure different cognitive abilities. Since the literature on Hispanic population has emphasized in the several similarities and differences within the member if this group, it is expected to find differences and similarities in the performance of the three groups.

METHOD

Participants

Descriptive statistics of demographic variables of the sample are provided in Table 1. One hundred and twenty subjects participated on this research study. Participants were young adults from cities areas in Puerto Rico, Chile and Dominican Republic. The mean age of the participants was 23.8 (SD = 3.2) years, and they had a mean of 15.7 (SD =1.6) years of education. Sixty-eight of the participants were females and 52 were males. Participants from Puerto Rico had a mean age of 22.8 (SD = 2.6) and a mean of 16.1 (SD = 1.7) years of study. Participants from Chile had a mean age of 24.8 (SD = 2.9) years of study. In Dominican Republic participants had a mean age of 23.8 (SD = 3.8) and a mean of 15.6 (SD = 1.6) years of study. The difference between age, gender, and education were not significant.

Materials

Table 1. Descriptive statistics of sample

	Gender		Age		Years of Study	
Country	Males	Female	M	SD	M	SD
N = 120	52	68	23.8	1.4	15.7	1.1
Puerto Rico (n=37)	16	21	22.8	2.6	16.1	1.7
Chile (n=41)	16	25	24.8	2.9	15.4	1.3
Dominican Republic (n=42)	20	22	23.8	3.8	15.6	1.6

All participants were tested on five different neuropsychological tasks that measure cognitive domains such as attention, concentration, memory, executive functions and visuo-spatial /visuo-motor abilities. These tests were used because they are commonly used on neuropsychological assessment, many of them have been adapted for Spanish speaking populations, and they are short and easy to administer. The following neuropsychological tests were administered to the participants.

Verbal Serial Learning Curve (Ardila, Roselli & Puente, 1994)

According to Ardila, Roselli and Puente (1994) the Serial Learning Test is one the most common test used to evaluate verbal memory. The authors described this test as a list of ten bisyllabic nouns, frequently used in Spanish, which is read to the participants in several trials until they are able to learn the ten words. After the list is read, the subjects try to recall as many words as possible. All the recalled words are registered, as well as the number of trials required to recall the ten words, and the number of intrusions. Ten minutes after completing this task, participants are asked again to recall the list of words. Verbal Serial Learning Curve measures verbal memory, short term memory span, intrusion, perseveration, and attention. Also, it provides information regarding the ability of subjects to memorize words, and also about the characteristics of the process of verbal learning (Ardila, Roselli & Puente, 1994).

Thus, this test is a source of multiple information regarding verbal memory. In this particular research, data analysis was focused on the number of words recalled in the first trial, the number of words recalled in the last trial, the number of trials required to recall the ten words, and the number of words recalled in the delay trial.

Rey- Osterrieth Complex Figure Test –ROCFT (Rey & Osterrieth, 1945)

In the ROCFT subjects are required to copy and recall an abstract lines drawing (Franzen, 1989). Subjects are asked to copy exactly a complex figure, and after a delay they are asked to draw what they remember of the figure. The ROCFT is a measure of spatial construction, planning, and visual learning (Akshoomoff & Stiles, 1995). Ardila,

Roselli and Puente (1994) discussed that currently ROCFT is one of the most popular tests used to evaluate constructional and visuo-spatial abilities.

The scoring criteria employed to analyze the performance of the participants of this study was the one published by Ostrosky-Solis and colleagues (2003) in the neuropsychological test battery Neuropsi. Using this criteria, a score is assigned to each one of the 18 parts that form the complex figure taking into consideration the size, shape, and location of each one of the elements. The highest score is 36 points.

Verbal Fluency Test- Semantic and Phonetic (Ardila, Roselli & Puente, 1994)

This test is an adapted Spanish version of the FAS Test (Benton & Hamsher, 1976), which is composed of a semantic and phonetic part. For the semantic part, subjects are required to name a list of animals and a list of fruits. For the phonetic part subjects are required to name as many words as possible beginning with a particular letter (e.g. A, S.). In both cases, subjects have one minute to produce the names (Ardila, Roselli & Puente, 1994). The score on this test is the number of correct responses. In addition to the subjects' correct responses, the repeated words, the intrusions, the perseverations, and the derivate words are recorded. Verbal Fluency Test is a measure of executive functions, cognitive switching, rule monitoring, and inhibition (Ostrosky-Solís, et. al., 2003).

Stroop- Color and Word Test (Golden, C.J., 1978)

The Stroop is a neuropsychological test composed of three parts. In the first part subjects are required to read aloud a list of color names (red, blue and green). In the second part subjects have to name the color of printed columns of Xs; and in the third part subjects are asked to name the color in which the name of a color is printed, but not to read the word (Franzen, 1989). The score is the number of correct responses produced in 45 seconds. The Stroop is a measure of perceptual interference and inhibition.

Trail Making Test (TMT) - Part A and Part B (Reitan & Wolfson, 1985)

TMT is a test included in the Halstead-Reitan Neuropsychological Test Battery, and is one of the most common tests employed in neuropsychological assessment as a

measure of visual search, scanning, speed of processing, mental flexibility, and executive functions (Tombaugh, 2003). This test includes two parts, Parts A and B. Subjects task on both parts is to connect with a line the sequence of circles as quickly as possible. As described in the administration manual, Part A consists of circles containing numbers from 1 to 25, and Part B consists of circles containing numbers from 1 to 13, as well it includes letters from A to L; in this part subjects have to connect the sequence alternating numbers and letters. The score for each part of the TMT is the time in seconds employed to complete the task, as well the number of errors. One important aspect of this test is that subjects need to be aware about the importance of completing the test as fast as the can, and to avoid making errors (Reitan & Wolfson, 1993).

Procedure

The participants of this study were recruited in many ways. Research collaborators in the different countries asked the potential participants if they were interested in participating in the study. After agreeing to participate in the study as volunteers, subjects were taken to a quiet area and completed the testing session. In Puerto Rico, subjects were contacted to make an appointment and complete the tasks. The testing session was conducted in public, but quiet, areas, in the participant's residences and/or in the researcher's residence. In Dominican Republic participants were contacted through the Psychology Department of the Universidad Iberoamericana. Subjects read and signed the consent form and took the tests in a nearby classroom. Also, other participants were contacted outside the university settings and were tested in their private homes. In Chile, participants were approached in the Hospital Penco Linquen. The participants were staff members and visitors (i.e. not patients) which read and signed the consent and completed the tests in a quiet area. Other participants were contacted outside the institution as well, and the testing session was conducted in private homes. Recruiting procedures were approved by the Institutional Review Board of the UNCW.

After explaining to participants the nature of the study and the requirements to participate, they read a consent form and signed it if they agreed to participate in the study. All researchers followed a test administration protocol where the administration of each one of the test was described step by step. A demographic data sheet was completed by the researchers as well, where important demographic data, such as country of origin, age, years of study, and handedness, of each participant was collected. All participants were tested in one session of approximately 20 minutes.

Each participant was individually tested, and the tests were administered in the same order across the three groups. Since the Verbal Learning Test and the ROCFT required a 10 minutes delayed recall, those tests were administered at the beginning of the testing session. Thus, the tests order was as follow: Verbal Learning Test, Rey-Osterrieth Complex Figure Test, Verbal Fluency Test, delayed recall of the Verbal Learning Test, delayed recall of the Rey-Osterieth Complex Figure Test, the Stroop test, and finally the Trail Making Tests.

RESULTS

The collected data was analyzed using the Statistical Package for the Social Sciences (SSPS) versions 12.0 and 14.0. The results are divided into three different sections. The first section includes preliminary group differences analyses in age and educational level. In the second section correlation analyses are provided. The last section includes group differences and similarities in the performance on the different neuropsychological measures.

Preliminary Group Difference Analyses

To determine whether there was a difference in age, gender, and educational levels across the three groups (Puerto Rico, Chile and Dominican Republic) analyses of variance (ANOVA) were conducted. The results showed non significant differences in age, $\underline{F}$ (13, 106) = 1.60, $\underline{p} > .05$, gender, $\underline{F}$ (1, 118) = .17, $\underline{p} > .05$, and in the educational levels across the three groups, $\underline{F}$ (2, 116) = 2.38, $\underline{p} > .05$. Thus, there is no need to

control for those variables when examining group differences. Additionally, to determine the relation between gender and country of origin a chi square of independence was conducted. The result revealed that there is not a significant relation between gender and country of origin, χ^2 (2, N= 120) = .62, $\underline{p} > .05$.

Pearson Correlations

Pearson correlations were performed to examine the relation between the study variables. Information about correlations is provided in Table 2. Age and years of study were significantly correlated, $\underline{r}$ (120) = .52, $\underline{p} < .01$. The older participants were, the more educated they were. In the Serial Learning Curve the number of trials required to recall the ten words was negatively correlated with the years of study, $\underline{r}$ (120) = -.33, $\underline{p} < .01$. Participants with more years of study required fewer trials to recall the ten words of the list. The number of trials required to recall the ten words was also correlated with gender $\underline{r}$ (120) = .20, $\underline{p} < .05$ (1=female; 2= male). Males required more trials to recall the ten words than females.

Group Differences and Similarities on Test Performance

A multiple analysis of variance (MANOVA) was conducted to determine whether there was a significant difference across the three groups. The dependent variables were the number of words recalled in the first trial, the number of words recalled in the last trial and the number of trials required to recall the ten words in the Serial Learning Curve; the scores in the copy and recall of the Rey-Osterrieth Complex Figure; the number of correct words in the Verbal Fluency Test; the interference score in the Stroop test; and the time completing the Trail Making A and B. The results revealed a significant multivariate difference in the performance of the three groups on the different neuropsychological tests, $\underline{F} = 2.70$, $\underline{p} < .05$.

To determine whether the three groups differed significantly from one another on specific tests, separate ANOVAs were conducted. There were significant univariate effects for four dependent variables. All other tests were no significant. Mean scores and

Table 2. Correlations between Study Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Country	---															
2. Age	.117	---														
3. Gender	.038	.058	---													
4. Years of study	-.117	.516**	-.156	---												
5. Handedness	-.082	.028	-.103	-.085	---											
6. 1st trial	.217*	.109	-.093	.021	.067	---										
7. Last trial	.136	-.004	.023	.198*	.083	.178	---									
8. # of trials	.263**	-.159	.203*	-.326**	-.028	-.365**	-.462**	---								
9. Delay	.065	-.126	.031	.087	.072	.053	.160	.137	---							
10. ROCF (copy)	-.176	.037	.038	.077	.032	.189*	.231*	-.119	.125	---						
11. ROCF (recall)	-.023	-.109	.139	.048	-.186	.022	.198**	-.012	.214*	.354**	---					
12. Semantic	.265**	.157	.036	.109	.025	.294**	.253**	-.349**	.069	.161	.189*	---				
13. Phonetic	.316**	.138	-.021	.092	.093	.237**	.047	-.335**	.008	.099	.007	.430**	---			
14. Stroop	.100	-.064	.091	.066	-.074	.134	.032	-.133	.124	-.225*	.095	.094	.038	---		
5. Trail Making A	.027	.093	-.127	-.047	.001	-.049	-.023	-.053	-.224**	-.271**	-.120	-.157	-.088	-.075	---	
16. Trail Making B	-.085	.094	.025	.044	-.090	-.240**	-.336**	.241**	-.098	-.308**	-.234*	-.254**	-.062	-.076	.326**	--

Note. *p < .05 **p <.01

standard deviations for the Serial Learning Curve are shown in Table 3. The results showed a significant difference between the three groups in the number of words recalled in the first trial of the Serial Learning Curve, F (2, 117) = 3.57, p <.05. Post hoc t-test results indicated a significant difference between Puerto Rico and Chile in the number of words recalled in the first trial of the Serial Learning Curve t (76) = -2.16, p < .05. Participants from Chile recalled more words than the participants from Puerto Rico. There was also a significant difference between Puerto Rico and Dominican Republic, t (77) = -2.35, p < .05. Participants from Dominican Republic recalled more words than the participants from Puerto Rico. No significant differences were found between Chile and Dominican Republic t (81) = -.28, p > .05

There was a significant difference in the number of trials required to recall the ten words of the Serial Learning Curve, F (2,117) = 5.39, p <.05. Post hoc t-tests revealed a significant difference between Chile and Dominican Republic, t (81) 2.75, p < .05. Participants from the Dominican Republic required fewer trials to recall the words than the participants from Chile. Also, there was a significant difference between participants from Puerto Rico and Dominican Republic, t (77) = 3.29, p < .05. Again, participants from the Dominican Republic required fewer trials to recall the words than the participants from Puerto Rico. There was no significant difference between Puerto Rico and Chile, t (76) = .24, p > .05.

There was also found a significant difference in the semantic part of the Verbal Fluency Test F (2, 117) = 6.46, p < .05. Mean scores and standard deviations for the Verbal Fluency Test are provided in Table 4. The results revealed a significant difference between participants from Chile and Dominican Republic in the semantic category of the

Table 3. Mean scores and standard deviations for the Serial Learning Curve

	Puerto Rico		Chile		Dominican Republic	
	M	SD	M	SD	M	SD
Serial Learning Curve						
First Trial	6.27	1.43	6.90	1.16	6.98	1.24
# of Trials	5.84	2.63	5.68	3.06	4.14	1.93

Table 4. Mean scores and standard deviations for the Verbal Fluency Test

	Puerto Rico		Chile		Dominican Republic	
	M	SD	M	SD	M	SD
Verbal Fluency Test						
Semantic	35.73	5.99	35.44	6.22	40.24	7.88
Phonetic	26.00	8.05	25.98	6.89	32.24	8.18

Verbal Fluency Test, t (81) = -3.07, p < .05. Participants from Dominican Republic produced more words in the categories of animals and fruits than the participants from Chile. There was also found a significant difference between participants from Puerto Rico and Dominican Republic, t (77) = -2.83, p < .05. Participants from Dominican Republic produced more words than the participants from Puerto Rico on this category. No significant difference was found between Puerto Rico and Chile, t (76) = .21, p > .05.

Finally, the results also indicated a significant difference in the phonetic part of the Verbal Fluency Test, F (2, 117) = 8.95, p < .05. Post hoc t-tests showed that Chile and Dominican Republic were significantly different t (81) = -3.77, p < .05. Participants from Dominican Republic produced more words beginning with the letters A and S than the participants from Chile. A significant difference between Puerto Rico and Dominican Republic was also found on this category t (77) = -3.41, p < .05. Once again, participants from Dominican Republic produced more words than the participants from Puerto Rico. No significant difference was found between Puerto Rico and Chile, t (76) = .01, p > .05. A summary of the results for the Serial Learning Curve and the Verbal Fluency Test are shown in Table 5.

DISCUSSION

The assessment of people of different cultural backgrounds has become a major challenge within the specialty of neuropsychology. There is a consensus regarding the implication of multiple variables such as age, education, language, but not necessarily culture in neuropsychological assessment.

The present study was conducted to determine whether different subgroups of Spanish speakers perform differently on a variety of neuropsychological tests. Three

Table 5. Summary of results for the Serial Learning Curve and the Verbal Fluency Test

Serial Learning Curve		Verbal Fluency Test	
Words in 1st Trial	Number of Trials	Semantic	Phonetic
Ch > PR	DR < PR	DR > Ch	DR > PR
DR > PR	DR < Ch	DR > PR	DR > PR
Ch & PR (N.S.)	PR & Ch (N.S.)	Ch & PR (N.S.)	Ch & PR (N.S.)

Note. PR = Puerto Rico, Ch = Chile, DR= Dominican Republic, N.S. = not significant at $p < .05$.

different groups of Spanish speakers from Puerto, Chile and Dominican Republic were compared on different tasks.

The three different groups of participants did not differ in age, gender, and educational level. Five different measures were used to compare the three groups and the results showed that the groups differed in four different components of two of the tests. The significant differences were found in the number of words recalled in the first trial and in the number of trials required to recall the ten words of the Serial Learning Curve and in the semantic and phonetic part of the Verbal Fluency Test.

Specifically, in the Serial Learning Curve, participants from Chile and Dominican Republic recalled more words in the first trial than did participants from Puerto Rico, Dominican Republic and Chile did not differ in the number of words recalled in the first trial. Regarding the number of trials required to recall the ten words of the list, participants from Dominican Republic needed fewer trials than those from Chile and Puerto Rico. Participants from Puerto Rico and Chile did not differ on this part of the Serial Learning Test.

As described by Ardila, Roselli and Puente (1994), the Serial Learning Curve test has been considered to be one of the most informative measures of memory, since it provides information about short-term memory span, verbal learning, confabulations, intrusions, perseverations, and attentional deficits. On this particular study, significant group differences were found on the number of words recalled in the first trial and in the number of trials required to recall the ten words included in the list. This may suggest differences in short-term memory span.

In the case of the Verbal Fluency Test, participants from Dominican Republic produced more names of animal and fruits, and more words beginning with the letter A and S than the participants from Chile and Puerto Rico. The groups of participants from Chile and Puerto Rico did not differ in neither of the categories of the Verbal Fluency Test.

The Verbal Fluency Test is another commonly used task in neuropsychological assessment (Azuma, 2004). It has been stated that this test measures language functions such as vocabulary size and naming, speed of response, mental organization, search strategies, short term memory, and long term memory (Kempler, Teng, Dick, Taussig, & Davis, 1998). The results indicated that the participants included in this study differed significantly in the number of words produced on the semantic and phonetic categories, which may imply differences on the above mentioned components.

The overall results of the current study showed that the performance of the three groups was similar on the remaining measures. Participants from the three different countries did not perform differently in the number of words recalled in the last trial of the Serial Learning Curve, in the copy and recall of the Rey-Osterrieth Complex Figure, in the delayed recall of the Serial Learning Curve, in the Stroop test, neither in the Trail Making A and B.

Different authors have highlighted the relevance of taking into consideration socio-cultural characteristics when assessing people from different cultural backgrounds (Shuttleworth-Edwards, et al., 2004). Education is a relevant key in this matter because of the role that interplays with other socio-cultural variables. For that reason it is important to conduct research where educational attainment is controlled in order to evaluate the

effect of other variables. In the present study, education was similar across the three samples. Despite this, two of the five measures were found to be significantly different across groups.

It would appear that despite the lack of focus on the role of culture in Neuropsychology, there is evidence not only that there is between ethnic group differences but significant within ethnic subgroup difference. Thus it would appear that evaluations of within groups' commonalities are important as well (Puente & Pérez-García, 2000b). Puente and Ardila (2000) stressed that issues related to the heterogeneity of Hispanics include aspects that go beyond scientific and clinical underpinnings (Puente & Ardila, 2000). The results of this study showed some differences across the groups, but a lot of similarities were observed in the performance on the different tests. It is important to say that differences found were on verbal tests, whereas the similarities were found on non-verbal tests.

The results of the current study are consistent with the results of a research conducted by Levav, Mirsky, French and Bartko (1998) regarding to the patterns of similarities and differences observed across the groups. These authors collected data from a sample composed by participants from five different countries (United States, Canada, Ecuador, and Israel) from eight to ninety years of age. They compared the performance of the different groups in several neuropsychological measures. The authors found similarities in reaction-time measures and differences in measures of attention and problem solving. Interestingly, the differences found tended to decrease with age. These authors concluded that the data supported the assumption of commonalities as well as differences of some neuropsychological functions across cultures.

Levav, et al., (1998) highlighted that the evaluation of similar manifestations of behaviors and performances represents a major topic of interest in cross-cultural psychology. Therefore, studies as the one conducted by these authors and the current one as well are critical in the comparisons of different groups of individuals. According to the authors, research studies of this nature are relevant to issues related to the construction of neuropsychological tests in different countries, specifically for aspects such as construct validity, sensitivity and specificity of the tests. Such information may produce a better understanding of the possibility that a neuropsychological "g" may exist across different cultures.

Regarding the facts related to assessment and the use of appropriate norms, Manly (2005) discussed some advantages and disadvantages associated to the development of separate norms, specifically for the African American population. According to this author, the establishment of separate norms represents an important contribution to the accuracy of diagnoses of neuropsychological tests. Also, when data on specific aspects such as cognition, demographic, medical, and psychiatry are collected, more hypotheses regarding the effects of culture on cognition can be generated. However, this author claimed that despite those advantages, there are some disadvantages associated to the generation of specific norms. Those disadvantages are associated to the fact that norms by themselves do not provide explanations about why ethnic differences are observed in cognitive test performance. Also, the lack of explanations may lead to misinterpretations.

Despite the relevance of the results of the present study, there are some limitations. First of all, the differences found between the groups could be attributed to different cognitive styles and cultural differences; however, it is difficult to say what

particular aspect may have lead to the differences found. Even though the tests used on this research included a variety of cognitive measures, there was not enough qualitative data to make the appropriate assumptions. It could be risky to give final explanations regarding the reasons of the differences found. Further research is necessary in order to evaluate other elements that may contribute to the differences.

Another limitation of the study is the fact that only three groups (countries) were included in the sample. It is possible that if additional groups were included that the patterns of commonalities and differences would change. Further, of importance is the fact that these individuals were relatively isolated, having been born and raised in the countries resided. Individuals from Hispanic countries that immigrate to other countries, especially North American ones, may produce an entirely different pattern of results. Also, only five neuropsychological measures were used to compare the groups. The use of additional tests where other different cognitive abilities were assessed may have provided a more comprehensive understanding of the performance of the three different groups.

One possible explanation to the pattern of differences observed may be the recruitment procedure and testing context. It is important to highlight the fact that even though there were not significant differences in age, gender, and education, the participants may have performed different because of some aspects of the testing procedure. Specifically, in Puerto Rico, participants were personally approached and testing was conducted at participants or researcher's residence. In Chile, the majority of participants were approached at a hospital. In contrast, most of the participants in

Dominican Republic were recruited through an university. This fact may have affected the way in which participants felt regarding the testing.

Despite limitations associated with this study, the data obtained is useful and relevant in the pursuit of understanding the role of culture in neuropsychological assessment. First of all, this study represents an important contribution to the understanding of the Hispanic population. Research focusing on issues such as the comprehension of similarities and differences within Hispanics are scarce. Studies that have already been done have not taken into consideration the importance of variables such as education, age, and country of origin. It has been indicated that despite the increase in cultural diversity in the United States, neurospychologists are mostly white and English speakers, thus there is a discrepancy between the population served and the people who provide the services (Echemendia, 2004).

The published studies regarding Hispanics have been focused on older adults with low education (e.g., Ardila, Rosselli & Puente, 1994). Since it has been reported that the Hispanic population is relatively young, it is imperative to understand the characteristics of this group. The contribution of this research to the specialty neuropsychology is important since it provides evidence regarding the significance of studying and evaluating differences and similarities within a group.

More research studies focusing on qualitative and quantitative aspects of neuropsychological assessment are necessary within and across ethnic groups. Such efforts will enhance the generalizability of Neuropsychology to emerging nations and populations and provide critical information about the interface of culture with brain function.

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APPENDIX

Appendix A. Institutional Review Board Approval

IRB Human Subjects Protocol Form
Revised May 2006

University of North Carolina Wilmington
Institutional Review Board
Human Subjects Protocol Form

For IRB Use Only
Protocol #: 2006-527
Approval Date: 7/25/06
Expiration Date: 7/25/07

PART A: GENERAL PROJECT INFORMATION

1. **Title of Project** (use same title as grant proposal, if applicable):
Neuropsychological Test Performance in Spanish Speakers: Is Neuropsychological Test Performance Similar Across Different Spanish Speaking Subgroups?

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2. **Project Type:**
☐ **Research** **Proposal #** _____ ***Attach a copy of the proposal**
☐ **Funded** **Account #** _____ ☐ **Under Review**
Funding Agency*: ☐ DOE ☐ NIH ☐ Other _____
☒ **Student Research** (Check if student is primary researcher and faculty is providing oversight only. If checked, provide student name at #7 below.)
☐ **Teaching** **Course Number:** _____

3. **Proposed Start Date:** July 2006 **Proposed End Date:** November 2006

IRB Use ONLY:
Type of IRB Review: ☐ **Full Review** ☒ **Expedited #** 7 ☐ **Exempt**
Results: ☒ **Approved** ☐ **Approved Pending Revisions** ☐ **Deferred** ☐ **Disapproved**

C Haudiu — **Signature of the IRB Chairperson** — 7/25/06 — **Date**

☐ **If necessary, revisions/clarification received:** _____
Results: ☐ **Approved** ☐ **Approved Pending Revisions** ☐ **Disapproved**

_____ — **Signature of the IRB Chairperson** — _____ — **Date**

4. **Principal Investigator:** (If student research, PI should be Faculty Advisor)

Name: Antonio E. Puente	**Date of IRB Training:** 5/26/03
Title: Professor	**Phone:**910-962-3812
Department: Psychology	**Fax:**910-962-7010
Campus Address: Social and Behavioral Sciences Building, Office 105D	**E-mail:**puente@uncw.edu
Mailing Address: Department of Psychology, University of North Carolina Wilmington, 601 S. College Road, Wilmington NC 28403-5612	

A copy of this page, signed by the IRB Chair, serves as formal notice of the approval of, disapproval of, or the need to revise this protocol. The protocol and consent form or assent/permission form are effective for ONE year from the date of approval. Any changes to this study, no matter how small, are subject to approval by the IRB. UNCW policy requires the submission of a Closure Report upon completion of a study. ***Please note: If this study will continue beyond the expiration date specified upon approval, it is the responsibility of the Principal Investigator to file an Annual Renewal Form prior to the expiration date. IRB forms are available at http://www.uncw.edu/ora/.***

1

Appendix B. Human Participant Protection Education for Research Teams Certificates

Completion Certificate

This is to certify that

Annelly Buré

has completed the **Human Participants Protection Education for Research Teams** online course, sponsored by the National Institutes of Health (NIH), on 08/24/2004.

This course included the following:

- key historical events and current issues that impact guidelines and legislation on human participant protection in research.
- ethical principles and guidelines that should assist in resolving the ethical issues inherent in the conduct of research with human participants.
- the use of key ethical principles and federal regulations to protect human participants at various stages in the research process.
- a description of guidelines for the protection of special populations in research.
- a definition of informed consent and components necessary for a valid consent.
- a description of the role of the IRB in the research process.
- the roles, responsibilities, and interactions of federal agencies, institutions, and researchers in conducting research with human participants.

National Institutes of Health
http://www.nih.gov

Completion Certificate

This is to certify that

Laura Sanchez

has completed the **Human Participants Protection Education for Research Teams** online course, sponsored by the National Institutes of Health (NIH), on 05/16/2006.

This course included the following:

- key historical events and current issues that impact guidelines and legislation on human participant protection in research.
- ethical principles and guidelines that should assist in resolving the ethical issues inherent in the conduct of research with human participants.
- the use of key ethical principles and federal regulations to protect human participants at various stages in the research process.
- a description of guidelines for the protection of special populations in research.
- a definition of informed consent and components necessary for a valid consent.
- a description of the role of the IRB in the research process.
- the roles, responsibilities, and interactions of federal agencies, institutions, and researchers in conducting research with human participants.

National Institutes of Health
http://www.nih.gov

Completion Certificate

This is to certify that

Jorge Gontier

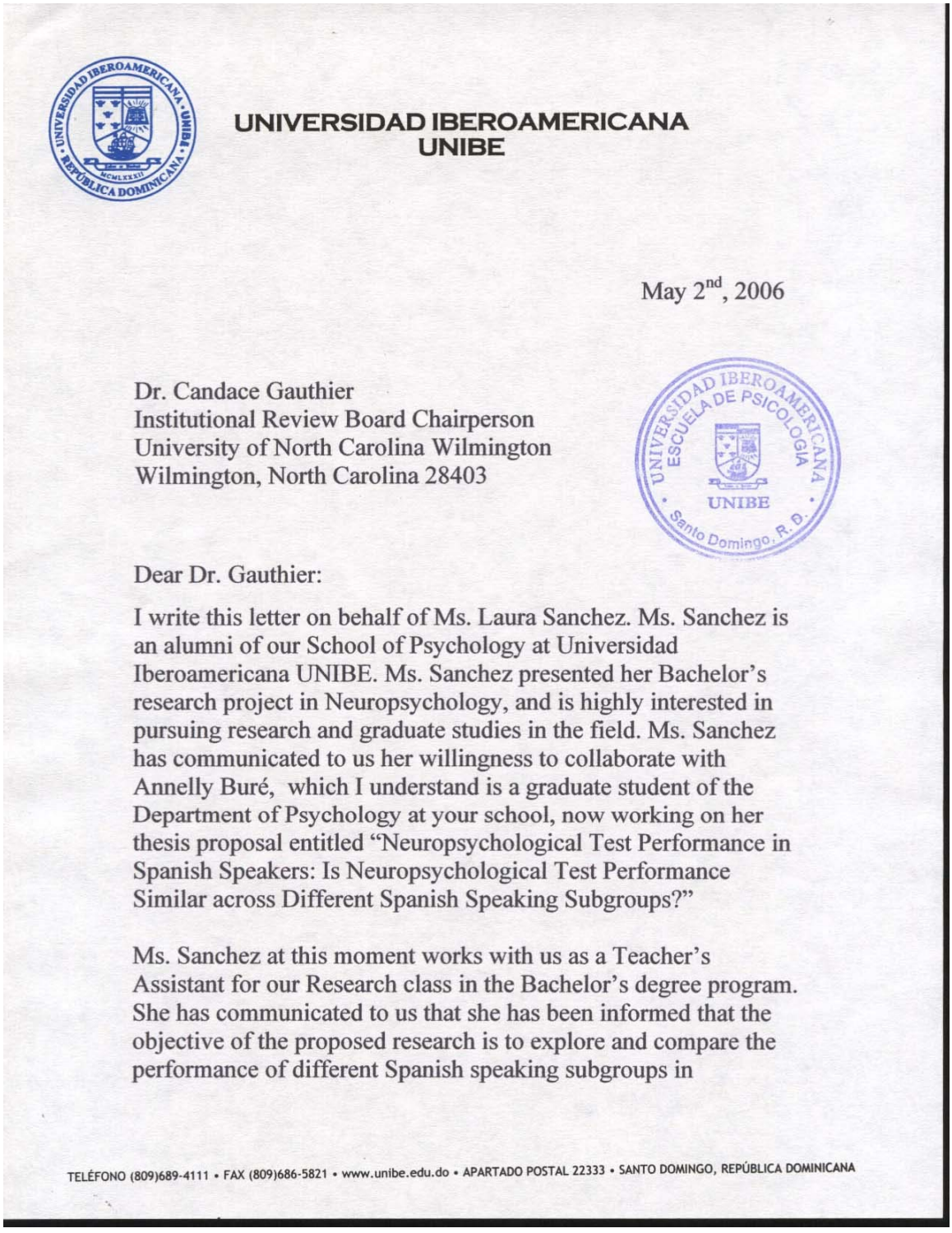
has completed the **Human Participants Protection Education for Research Teams** online course, sponsored by the National Institutes of Health (NIH), on 06/24/2006.

This course included the following:

- key historical events and current issues that impact guidelines and legislation on human participant protection in research.
- ethical principles and guidelines that should assist in resolving the ethical issues inherent in the conduct of research with human participants.
- the use of key ethical principles and federal regulations to protect human participants at various stages in the research process.
- a description of guidelines for the protection of special populations in research.
- a definition of informed consent and components necessary for a valid consent.
- a description of the role of the IRB in the research process.
- the roles, responsibilities, and interactions of federal agencies, institutions, and researchers in conducting research with human participants.

National Institutes of Health
http://www.nih.gov

Appendix C. Letters of Support



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May 2nd, 2006

Dr. Candace Gauthier
Institutional Review Board Chairperson
University of North Carolina Wilmington
Wilmington, North Carolina 28403

UNIVERSIDAD IBEROAMERICANA
ESCUELA DE PSICOLOGIA
UNIBE
Santo Domingo, R.D.

Dear Dr. Gauthier:

I write this letter on behalf of Ms. Laura Sanchez. Ms. Sanchez is an alumni of our School of Psychology at Universidad Iberoamericana UNIBE. Ms. Sanchez presented her Bachelor's research project in Neuropsychology, and is highly interested in pursuing research and graduate studies in the field. Ms. Sanchez has communicated to us her willingness to collaborate with Annelly Buré, which I understand is a graduate student of the Department of Psychology at your school, now working on her thesis proposal entitled "Neuropsychological Test Performance in Spanish Speakers: Is Neuropsychological Test Performance Similar across Different Spanish Speaking Subgroups?"

Ms. Sanchez at this moment works with us as a Teacher's Assistant for our Research class in the Bachelor's degree program. She has communicated to us that she has been informed that the objective of the proposed research is to explore and compare the performance of different Spanish speaking subgroups in

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neuropsychological tasks. And that she has read and reviewed the objectives and purposes of the proposed research, and agrees to be part of the group of collaborators, specifically by providing the necessary support for the data collection process with the Dominican sample.

Ms. Sanchez is very commited to the field of neuropsychology, as I said before, her dream is to conduct research and further her studies in the field. We, as well as Ms. Sanchez consider that this is an important area in the discipline of Psychology.

Aside from working in her own research papers, Ms. Sanchez has had the experience to work with professors on research papers, to participate in university's pedagogical workshops.

Cordially,

Laura Sánchez, B.A.
Collaborator in data collection

Francesca Hernández, M.A.
Coordinator
Department of Psychology
UNIBE

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March 24, 2006

Dr. Candace Gauthier
Institutional Review Board Chairperson
University of North Carolina Wilmington
Wilmington, North Carolina 28403

Dear Dr. Gauthier:

After reviewing the thesis proposal entitled "Neuropsychological Test Performance in Spanish Speakers: Is Neuropsychological Test Performance Similar across Different Spanish Speaking Subgroups?" which is intended to be conducted by Annelly Buré, a graduate student of the Department of Psychology of the University of North Carolina, Wilmington, I have concluded that I will be able to collaborate with this research.

I have been informed that the objective of the proposed research is to explore and compare the performance of different Spanish speaking subgroups in neuropsychological tasks. I have read and review the objectives and purposes of the proposed research, and I agree to be part of the group of collaborators, specifically by providing the necessary support for the data collection process in Chile. I consider that this is an important topic which study will produce a significant contribution to the discipline of psychology.

Cordially,

DR. JORGE NOVOA MUÑOZ
DIRECTOR
HOSPITAL PENCO LIRQUEN

Appendix D. Research Protocol

Neuropsychological Test Performance in Spanish Speakers: Is Neuropsychological Test Perfomance Similar Across Different Spanish Speakers Subgroups?

PROTOCOLO

El propósito de este estudio es comparar el desempeño de diferentes grupos de hispanos en tareas neuropsicológicas que miden atención, concentración, memoria, funciones ejecutivas y habilidades visuales y motoras.

El estudio consiste de una sección de aproximadamente 20 minutos donde se le presentarán cinco tareas cortas y sencillas para que usted complete luego de que se le explique las instrucciones. Por ejemplo, una de las tareas consiste en repetir todas las palabras que pueda recordar de una lista.

Antes de empezar las pruebas le voy a mostrar una hoja de consentimiento donde hay más información acerca del propósito de este estudio y su participación en el mismo.

Dos cosas importantes acerca de su participación en este estudio son las siguientes:

1. **Primero, su participación es completamente voluntaria.**
2. **Segundo, toda la información obtenida a través de este estudio es anónima.**

Antes de empezar me gustaría que lea la hoja de consentimiento y que la firme si no tiene ninguna duda y está de acuerdo en formar parte del estudio.

ADMINISTRACION DE PUEBAS

Orden en que deben administrarse las pruebas
1- Curva de Aprendizaje Verbal.
2- Copia de la figura compleja Rey-Osterrieth.
3- Prueba de fluidez verbal- semántica y fonética.
4- Evocación de listas de palabras de la prueba Curva de Aprendizaje Verbal (diez minutos después de haberse completado la prueba).
5- Prueba Stroop.
6-Prueba de conexiones rápidas.
7-Evocación de la copia de la figura compleja Rey-Osterrieth (diez minutos después de haberse completado la prueba).

1- ***Curva de aprendizaje verbal*** (Verbal Serial Learning Curve)

Instrucciones:

- "Voy a leerle una lista de palabras; cuando yo termine quiero que diga todas las palabra que pueda recordar, en cualquier orden".

- Después que se lee la lista de palabras, cada participante trata inmediatamente de repetir las palabras que puede recordar. El investigador debe anotar en el espacio provisto debajo de cada palabra el orden en que el participante repitió las palabras.

- Cuando el participante termine de repetir las palabras, el investigador lee la lista nuevamente luego de dar las siguientes instrucciones: "Ahora voy a leer la misma lista de palabras, y quiero que diga todas las palabras que pueda recordar en cualquier orden; no importa si dijo las mismas palabras en el intento anterior".

- El investigador registra nuevamente el orden de las palabras recordadas por el participante. La lista de palabras se lee a cada participante hasta un máximo de 10 veces o hasta que el participante se capaz de repetir las 10 palabras incluidas en la lista.

- **Diez minutos** después de completar esta prueba, se le pregunta nuevamente al participante que repita todas las palabras que puede recordar de la lista (sin leerle las palabras).

- **Nota:** Anotar la hora en que el participante termina la tarea para calcular los diez minutos que beben transcurrir para solicitar la repetición de las palabras que el participantes pueda recordar.

2- ***Copia de la figura compleja Rey-Osterrieth*** (Rey- Osterrieth Complex Figure Test)

Instrucciones:

- Se coloca la figura frente al participante y se le proporciona una hoja blanca, colocada en posición horizontal, y un lápiz, y se le da la siguiente instrucción: "Observe con atención esta figura y dibújela en esta hoja tal y como la ve. Más tarde le voy a pedir que dibuje nuevamente todos los detalles que recuerde de la figura".

- No se permite utilizar regla, borrar, mover la orientación de la lámina modelo, ni la hoja en que se está copiando la figura.

- Dejar la lámina a la vista del sujeto mientras se realiza la copia. El tiempo límite para realizar la copia es de cinco minutos. **Se registra la secuencia de la copia** en una hoja que contiene la figura y las unidades que la componen.

- **Diez minutos** después se solicita la evocación de la figura (no se presenta la figura modelo; también debe registrarse la secuencia).

- **Nota:** Anotar la hora en que el participante finaliza la tarea para calcular los 10 minutos que deben transcurrir antes de solicitar la evocación de la figura.

3- ***Prueba de fluidez verba- semántica y fonética*** (Verbal Fluency Test- FAS)

- El investigador le pide al participante que mencione todas las palabras posibles que empiezan con una letra particular (A ó S) o que pertenezcan a un grupo semántico en particular (animales, vegetales o frutas). Se le da una palabra de ejemplo. El investigador anota todas las palabras que el participante mencione (incluso las que estén incorrectas) y anota el tiempo. Cada participante tiene **un minuto** para mencionar las palabras en cada categoría.

- En la parte semántica el investigador dice "mencione todos los animales que sean posible". Luego de un minuto le pide que "mencione todas las frutas posibles".

- En la parte fonológica el investigador le pide al participante que "mencione todas las palabras posibles que empiezan con la letra S". Un minuto después el investigador dice: "Ahora vamos a intentar con la letra A, listo?" Se le debe indicar al participante que nombres propios no están permitidos.

4- Stroop- Test de colores y palabras (Stroop- Color and word test)

Instrucciones:

- Después de presentar la hoja frente al participante diga:

"Esta prueba se trata de evaluar la velocidad con que usted puede leer las palabras escritas en esta página. Cuando yo se lo indique, empezará a leer en voz alta la columna de palabras, de arriba hacia abajo, comenzando por la primera (señalar la primera columna de la izquierda) hasta llegar al final de la misma (mostrar con la mano, moviéndola de arriba abajo en la primera columna); después continuará leyendo, por orden, las siguientes columnas sin detenerse (mostrar con la mano la segunda columna, la tercera, etc.)

Si termina de leer todas las columnas antes de que yo le indique que se ha terminado el tiempo concedido, volverá a la primera columna (señalar) y continuará leyendo hasta que dé la señal de terminar.

Recuerde que no debe interrumpir la lectura hasta que yo le diga "Basta!" y que debe leer en voz alta tan rápidamente como le sea posible. Si se equivoca en una palabra yo diré "NO" y usted corregirá el error volviendo a leer la palabra correctamente y continuará leyendo sin detenerse. Quiere hacer una pregunta sobre la forma de realizar esta prueba?"

"Está preparado?... Entonces comience!"

- En este momento se pone el cronómetro en marcha. Cuando hayan transcurrido 45 segundos se dice: "Basta! Rodee con un círculo la última palabra que ha leído. Si ha terminado toda la página y ha vuelto a empezar ponga un 1 dentro del círculo. Ahora pase a la página siguiente."

- Las instrucciones para la segunda parte son iguales que las de la primera excepto que el comienzo es el siguiente: "En esta parte de la prueba se trata de saber con cuánta rapidez puede nombrar los colores de cada uno de los grupos de X que aparecen en la página". Como en la primera página se concede un tiempo de 45 segundos.

- Tercera parte: "Esta página es parecida a la utilizada en el ejercicio anterior. En ella debe decir el color de la tinta con que está escrita cada palabra, sin tener en cuenta el significado de esa palabra. Por ejemplo (se señala la primera palabra de la columna), qué diría usted en esta palabra?"

  "Bien, ahora continuará haciendo esto mismo en toda la página. Comenzará en la parte de arriba de la primera columna (señalar) y llegará hasta la base de la misma; luego continuará de la misma manera en las columnas restantes. Debe trabajar tan rápidamente como le sea posible. Recuerde que si se equivoca tiene que corregir su error y continuar sin detenerse. Quiere hacer alguna pregunta?"

  "Puede comenzar!"

- Se pone en marcha el cronómetro y cuando hayan transcurrido 45 segundos, se dice: "Basta! Rodee con un círculo la última palabra que ha dicho".

6- Test de conexiones rápidas (Trail-making test)

- Coloque el ejemplo de la parte A hacia arriba, enfrente del participante. Déle un lápiz bien afilado al participante y diga: "Mire los números que hay en esta hoja (muéstreselos). Empiece en el 1 y trace una línea del 1 al 2 (señale del 1 al 2), del 2 al 3 (señale), del 3 al 4 (señale) y siga de esta manera hasta que llegue al final (señale el círculo que dice "END"). Trace las líneas lo más rápido que pueda. Listo? Empiece!"

- Si el participante termina el ejemplo correctamente y da muestras que sabe lo que debe hacer diga: "Muy bien. Hagamos el siguiente" (déle la vuelta al papel y pídale al participante que complete la parte A de la prueba).

- Si el participante comete un error en el ejemplo de la parte A muéstreselo y explíqueselo. Las siguiente explicaciones sirven como ejemplo:

1- Empezó con el círculo incorrecto. Aquí es donde debe comenzar (muéstrele el número 1).
2- Omitió este círculo (señale el círculo omitido). Debe de ir del número 1 (señale el 1) al 2 (señale el 2), del 2 al 3 (señales el 3), y seguir de esta manera hasta llegar al último círculo (señálelo).

- Muéstrele la parte A la participante y diga: "En esta página hay números del 1al 25. Hágalo en la misma forma. Empiece con el número 1 (señálelo) y trace una línea del 1 al 2 (señale), del 2 al 3 (señale), del 3 al 4 (señale), y siga de esta manera, en orden hasta que llegue al final (señale el final). Recuerde que debe trabajar lo más rápidamente posible. Listo? Empiece!"

- Empiece a medir el tiempo con el cronómetro tan pronto como las instrucciones para empezar hayan sido dadas. El examinador deber corregir inmediatamente cualquier error que el participante cometa. Cuando cometa un error indíqueselo inmediatamente y pídale que prosiga desde donde el error ocurrió (NO PARE EL CRONOMETRO).

- Parte B- Coloque la hoja de la parte B con el ejemplo hacia arriba. Señale el ejemplo y diga: "En esta hoja hay números y letras. Empiece con el número 1 (señale el 1) y trace una línea del 1 a la letra "A" (señale la A), de la A al 2 (señale el 2), del 2 a la letra "B" (señale la B), de la B al 3 (señale el 3), del 3 a la letra "C" (señale la C), y siga de esta manera en orden hasta llegar al final (señale el final) Recuerde que primero tiene un número y después una letra… Trace las líneas lo más rápido que pueda. Listo? Empiece!"

- Muéstrele al participante la parte B (diga las mismas instrucciones que en el ejemplo). Continúe la prueba de la misma manera que en la parte A.

Appendix E. Consent Form

HOJA DE CONSENTIMIENTO INFORMADO

El desempeño en pruebas neuropsicológicas en hispano hablantes: ¿Es el desempeño en pruebas neuropsicológicas similar dentro de diferentes subgrupos de hispano hablantes?

Usted ha sido invitado a participar en una investigación sobre neuropsicología. La neuropsicología es un área de la Psicología que estudia la relación entre el cerebro y la conducta. Esta investigación es sobre el desempeño de diferentes grupos de hispano hablantes en tareas neuropsicológicas que miden atención, concentración y memoria. Esta investigación es realizada por Annelly Buré Reyes, estudiante del programa graduado de Psicología de la Universidad de Carolina del Norte, Wilmington, el Dr. Antonio E. Puente y un grupo de colaboradores.

El propósito de esta investigación es hacer una comparación en el desempeño de grupos de hispanos de cuatro diferentes países (Puerto Rico, República Dominicana y Chile) en tareas cortas y sencillas que requieren procesos de atención, concentración y memoria.

Usted fue seleccionado para participar en esta investigación ya que los participantes que se necesitan para este estudio deben ser entre las edades de 18 a 30 años de edad y que tengan, como mínimo, doce aňos de estudios, por lo que usted cumple con los criterios para formar parte del estudio. Se espera que este estudio participen aproximadamente 126 personas como voluntarias.

Si acepta participar en esta investigación, se le solicitará que complete una serie de tareas cortas que requieren atención, concentración y memoria, como por ejemplo repetir una lista de palabras o copiar una figura en un papel.

El participar en este estudio le tomará aproximadamente 20 minutos.

Los riesgos asociados a esta investigación son mínimos.

Esta investigación no conlleva beneficios directos para el participante.

Toda información o datos del participante serán anónimos. No se requiere ninguna información personal y/o confidencial para participar en este estudio.

Solamente la estudiante Annelly Buré, el Dr. Antonio E. Puente y los colaboradores asociados al estudio tendrán acceso a los datos crudos o que puedan identificar directa o indirectamente un participante, incluyendo esta hoja de consentimiento. Estos datos serán almacenados en un archivo bajo llave en una oficina de la Universidad de Carolina del Norte, Wilmington, por un período de un año una vez concluya el estudio.

Si ha leído este documento y ha decidido participar, por favor entienda que su participación es completamente voluntaria y que usted tiene derecho a abstenerse de participar o retirarse del estudio en cualquier momento, sin ninguna penalidad. También tiene derecho a no contestar alguna pregunta en particular. Además tiene derecho a recibir una copia de este documento.

Si tiene alguna pregunta o desea más información sobre esta investigación, por favor comuníquese con Annelly Buré Reyes al número de celular 910-297-8674.

Su firma en este documento significa que ha decidido participar después de haber leído y discutido la información presentada en esta hoja de consentimiento.

_____	_____	_____
Nombre del Participante	Firma	Fecha

He discutido el contenido de esta hoja de consentimiento con el arriba firmante. Le he explicado los riesgos y beneficios del estudio.

_____	_____	_____
Nombre del investigador o persona designada	Firma	Fecha

Appendix F. Demographic Sheet

Código: _____

DATOS DEMOGRAFICOS

Lugar y Fecha de Nacimiento: _____

Edad: _____

Género: _____

Años de estudios y/o
preparación académica: _____

Derecha: _____ Izquierda: _____

Appendix G. Serial Learning Curve

Curva de Aprendizaje Verbal

Nombre_____ Edad_____
Escolaridad_____ Fecha_____
Examinador_____

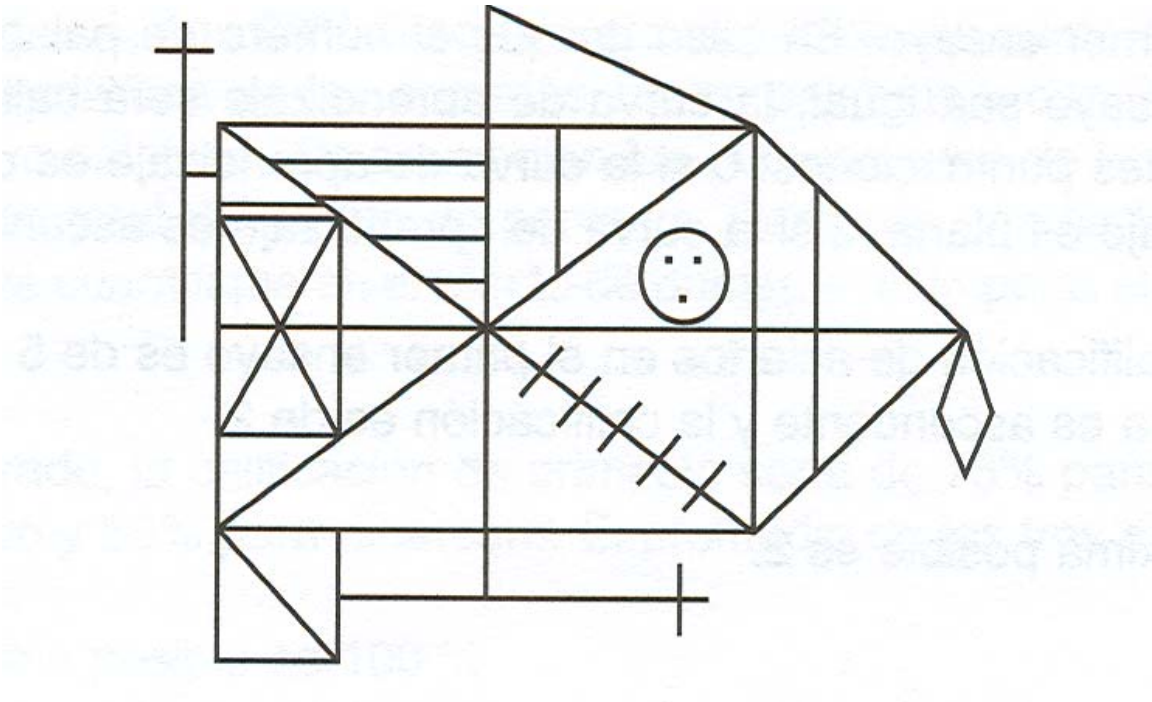
_____

	niño	perro	rosa	luna	piso	mesa	casa	cama	gato	lápiz	Total
Ensayo 1	___	____	____	____	____	____	____	____	____	____	____
Ensayo 2	___	____	____	____	____	____	____	____	____	____	____
Ensayo 3	___	____	____	____	____	____	____	____	____	____	____
Ensayo 4	___	____	____	____	____	____	____	____	____	____	____
Ensayo 5	___	____	____	____	____	____	____	____	____	____	____
Ensayo 6	___	____	____	____	____	____	____	____	____	____	____
Ensayo 7	___	____	____	____	____	____	____	____	____	____	____
Ensayo 8	___	____	____	____	____	____	____	____	____	____	____
Ensayo 9	___	____	____	____	____	____	____	____	____	____	____
Ensayo 10	___	____	____	____	____	____	____	____	____	____	____
Evocación Diferida	___	____	____	____	____	____	____	____	____	____	____

Número de palabras en el primer ensayo _____
Número de palabras en el último ensayo _____
Número de ensayos requeridos _____ Intrusiones _____
Número de veces en que una palabra se repite en el mismo ensayo _____

Tipo de curva: Productiva Improductiva Estereotipada Desorganizada
Número de palabras en memoria diferida (después de 10-15 minutos)

Appendix H. Rey-Osterrieth Complex Figure



Appendix I. Verbal Fluency Test

Prueba de Fluidez Verbal

Animales	Frutas	F	A	S

Total semántica _____ Promedio _____
Total fonológico _____ Promedio _____
Errores por repetición _____ Intrusiones _____
Palabras derivadas _____ Nombres propio _____

Appendix J. Stroop

Nº 226

STROOP

Test de Colores y Palabras

Nombre: _____

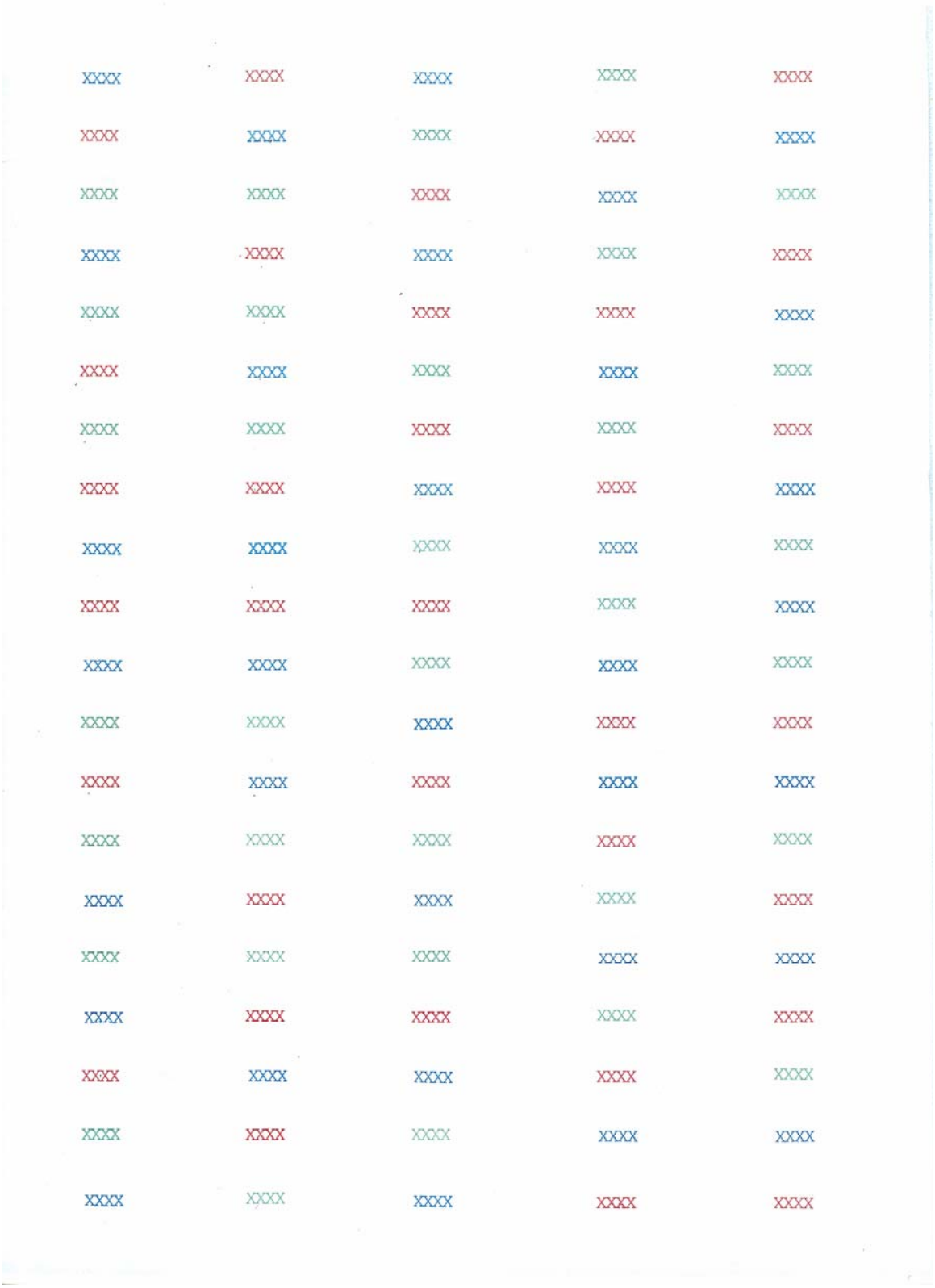
Edad: _____ Sexo: _____ Fecha: _____

PARA USO DEL PROFESIONAL

	PD	PT
P		
C		
PC		
$\frac{P \times C}{P + C} = PC'$		
PC - PC' = INTERF.		

NO ABRA EL CUADERNILLO
HASTA QUE SE LE INDIQUE

ROJO	AZUL	VERDE	ROJO	AZUL
VERDE	VERDE	ROJO	AZUL	VERDE
AZUL	ROJO	AZUL	VERDE	ROJO
VERDE	AZUL	ROJO	ROJO	AZUL
ROJO	ROJO	VERDE	AZUL	VERDE
AZUL	VERDE	AZUL	VERDE	ROJO
ROJO	AZUL	VERDE	AZUL	VERDE
AZUL	VERDE	ROJO	VERDE	ROJO
VERDE	ROJO	AZUL	ROJO	AZUL
AZUL	VERDE	VERDE	AZUL	VERDE
VERDE	ROJO	AZUL	ROJO	ROJO
ROJO	AZUL	ROJO	VERDE	AZUL
VERDE	ROJO	AZUL	ROJO	VERDE
AZUL	AZUL	ROJO	VERDE	ROJO
ROJO	VERDE	VERDE	AZUL	AZUL
AZUL	AZUL	ROJO	VERDE	ROJO
ROJO	VERDE	AZUL	ROJO	VERDE
VERDE	ROJO	VERDE	AZUL	AZUL
ROJO	AZUL	ROJO	VERDE	ROJO
VERDE	ROJO	VERDE	AZUL	VERDE



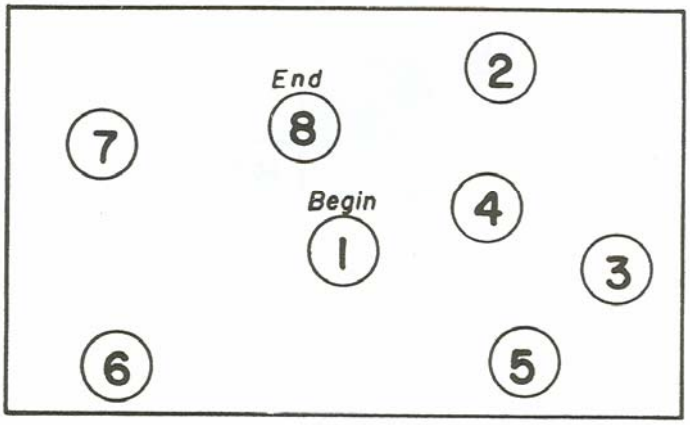
ROJO	AZUL	VERDE	ROJO	AZUL
VERDE	VERDE	ROJO	AZUL	VERDE
AZUL	ROJO	AZUL	VERDE	ROJO
VERDE	AZUL	ROJO	ROJO	AZUL
ROJO	ROJO	VERDE	AZUL	VERDE
AZUL	VERDE	AZUL	VERDE	ROJO
ROJO	AZUL	VERDE	AZUL	VERDE
AZUL	VERDE	ROJO	VERDE	ROJO
VERDE	ROJO	AZUL	ROJO	AZUL
AZUL	VERDE	VERDE	AZUL	VERDE
VERDE	ROJO	AZUL	ROJO	ROJO
ROJO	AZUL	ROJO	VERDE	AZUL
VERDE	ROJO	AZUL	ROJO	VERDE
AZUL	AZUL	ROJO	VERDE	ROJO
ROJO	VERDE	VERDE	AZUL	AZUL
AZUL	AZUL	ROJO	VERDE	ROJO
ROJO	VERDE	AZUL	ROJO	VERDE
VERDE	ROJO	VERDE	AZUL	AZUL
ROJO	AZUL	ROJO	VERDE	ROJO
VERDE	ROJO	VERDE	AZUL	VERDE

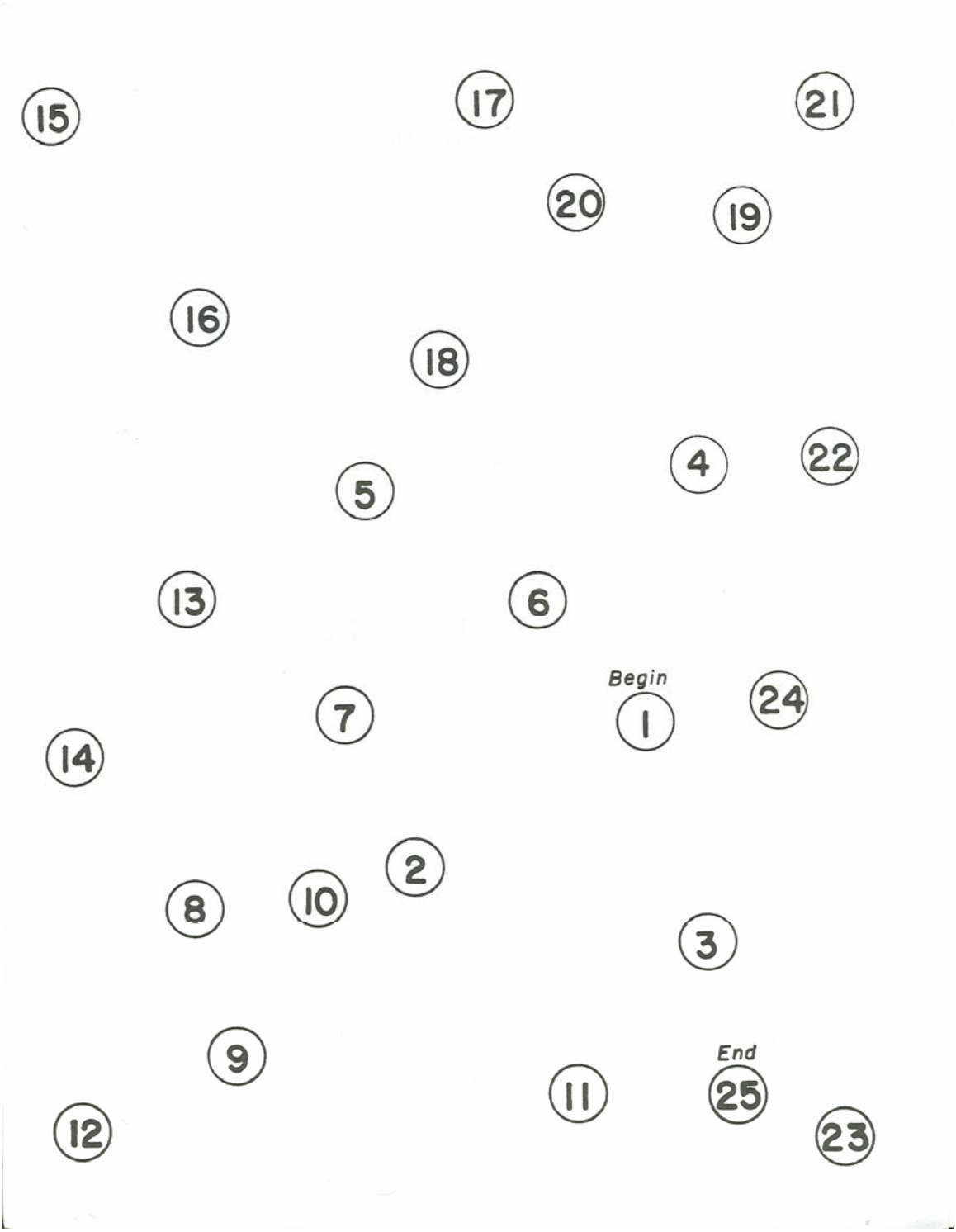
Appendix K. Trail Making A

TRAIL MAKING

Part A

SAMPLE

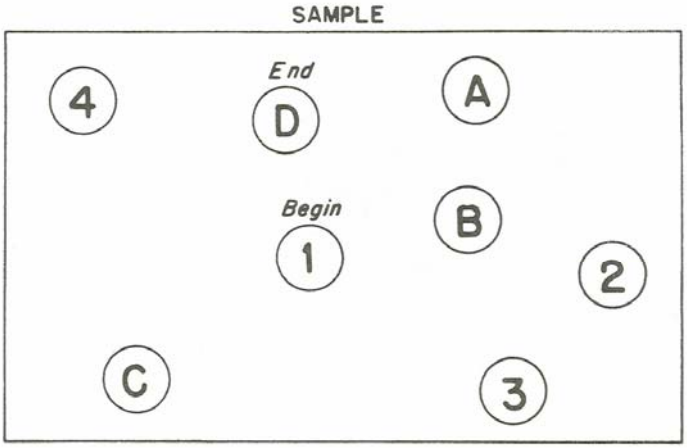


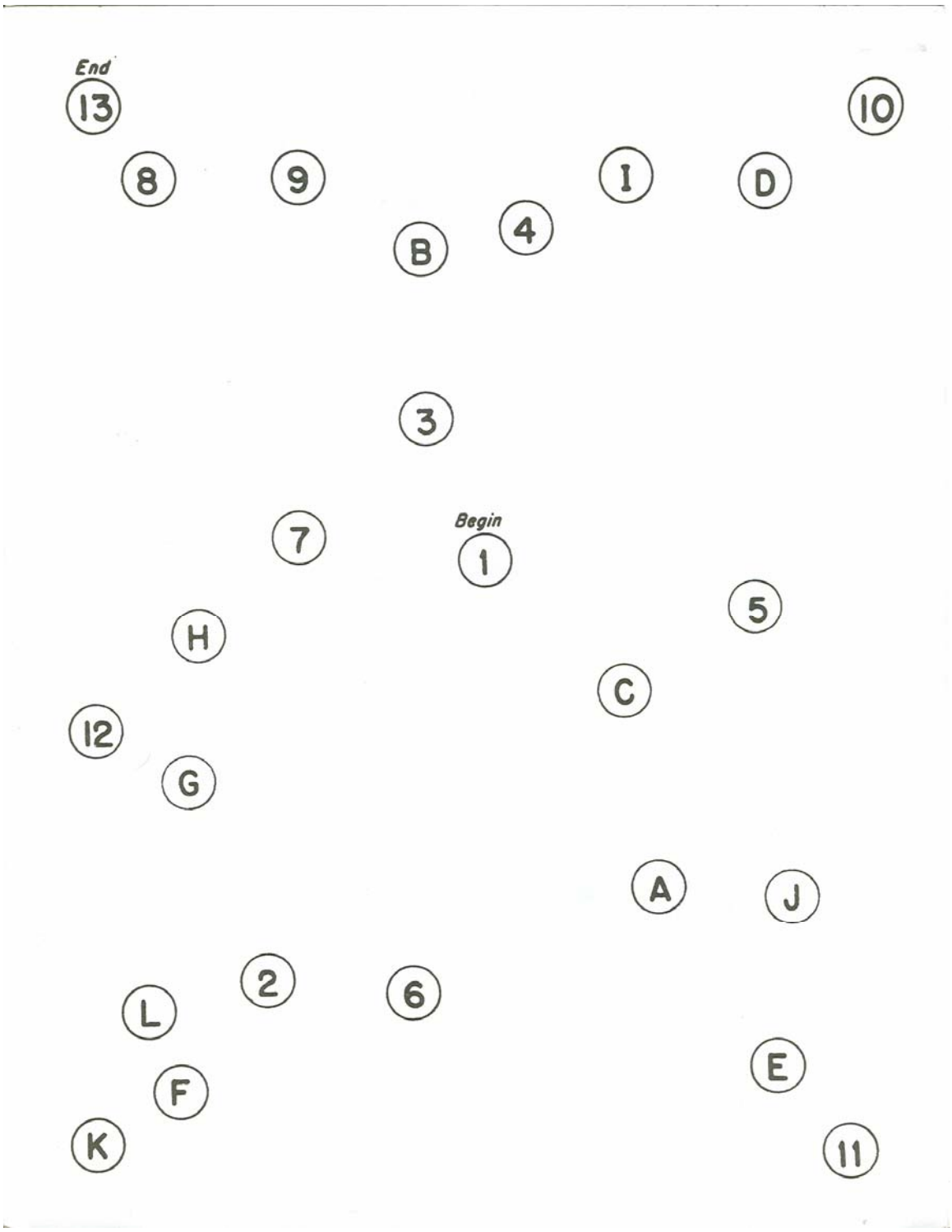

15
17
21
20
19
16
18
4
22
5
13
6
Begin
24
7
1
14
2
8
10
3
9
End
11
25
12
23

Appendix L. Trail Making B

TRAIL MAKING

Part B




End
13
10
8
9
I
D
4
B
3
7
Begin
1
5
H
C
12
G
A
J
2
6
L
E
F
K
11